NON-PUBLIC?: N
ACCESSION #: 9506200342
LICENSEE EVENT REPORT (LER)

FACILITY NAME: Duane Arnold Energy Center PAGE: 1 OF 4

DOCKET NUMBER: 05000331

TITLE: Reactor Scram due to Feedwater Pump Trip Caused by Lube Oil Pump Coupling Failure
EVENT DATE: 05/14/95 LER #: 95-005-00 REPORT DATE: 06/12/95

OTHER FACILITIES INVOLVED: DOCKET NO: 05000

OPERATING MODE: N POWER LEVEL: 100

THIS REPORT IS SUBMITTED PURSUANT TO THE REQUIREMENTS OF 10 CFR SECTION:
50.73(a)(2)(iv)

LICENSEE CONTACT FOR THIS LER:
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COMPONENT FAILURE DESCRIPTION:
CAUSE: X SYSTEM: SJ COMPONENT: CPLG MANUFACTURER: D055
B SJ PMC G080
REPORTABLE NPRDS: Y
Y

SUPPLEMENTAL REPORT EXPECTED: NO

ABSTRACT:

On May 14, 1995, with the plant operating at 100% power, a full automatic reactor scram occurred due to low reactor water level caused by a trip of the B reactor feedwater pump. The pump tripped due to loss of lube oil pressure caused by a lube oil pump drive shaft coupling failure. The coupling failed due to a lack of lubrication caused by a plugged lube oil supply orifice.

All control rods inserted and Primary Containment Isolation System (PCIS) isolations, Groups 2-5, occurred as designed. Reactor water level control following the scram was complicated by problems with the A feedwater regulating valve controller but vessel level and pressure were maintained within safe operating limits. There were no emergency core

cooling system actuations and no safety relief valve openings.

The failed coupling and the plugged orifice were replaced and the coupling and orifice for the A feedwater pump were inspected. The maintenance procedure, the vendor manual, and plant drawings for the feedwater pumps are being revised to ensure proper lubrication of the coupling. The controller was modified and the part number description for the controller has been changed to ensure that required modifications are made. The plant was re-started on May 17, 1995.

END OF ABSTRACT

Description of Event:

On May 14, 1995 the plant was operating at 100% power. The plant was in day 3 of a 30 day Limiting Condition for Operation (LCO) for containment atmosphere monitoring but this had no effect on the event. At 2258 hours, the B Reactor Feedwater Pump (RFP) tripped. Although maximum feedwater flow with the A-RFP was promptly established, reactor water level dropped to 170 inches causing an automatic reactor scram 28 seconds after the B-RFP trip. Primary Containment Isolation System (PCIS) isolations, Groups 2-5, occurred at the 170 inch level as designed. All control rods inserted and all PCIS isolations were complete. Additionally, both reactor recirculation pumps ran back to 45% speed as designed at a vessel level of 186 inches concurrent with only one RFP in service.

Following the scram, expected core void collapse caused reactor water level to drop to a minimum of 127 inches before level started rising due to the operable A-RFP. To return vessel level to normal (approximately 190 inches), the operator dialed the B Feedwater Regulating Valve (FRV) controller to minimum then dialed the A-FRV controller to minimum. Due to a perceived slow response of the A-FRV to increasing vessel level, the operator placed the controller in manual. When the A-FRV controller was placed in manual, the A-FRV locked up The operator then manually secured the A-RFP at 2259 hours as level approached 187 inches. Due to expected level swell, reactor water level continued to rise to a maximum of 217 inches with a main turbine trip occurring at 211 inches as designed at 2300 hours.

At 2303 hours, the scram and the PCIS isolations were reset and Reactor Water Cleanup (RWCU) flow was re-established. As vessel level returned to normal, the A-RFP was re-started and feedwater flow was restored. There were no Emergency Core Cooling System (ECCS) actuations and no

Safety Relief Valve (SRV) openings during the event. Reactor pressure dropped from 1021 psig to 878 psig during the event and was controlled by the turbine bypass valves. The reactor was re-started on May 17, 1995 after corrective actions were completed.

Cause of Event:

The scram occurred due to low reactor water level caused by a trip (on low lube oil pressure) of the B-RFP. The loss of lube oil pressure was caused by a worn gear type coupling between the B-RFP and its shaft driven lube oil pump. The cause of the coupling failure was a lack of lubrication caused by a plugged oil pump drive shaft orifice (Root Cause of Scram) through which oil must pass to lubricate the coupling. The .030 inch orifice was plugged with an accumulation of crud from 20 years of plant operation. Additionally, a small piece of fibrous material was found at the orifice. The origin and age of this material could not be determined. Neither plant procedures nor the vendor manual for the reactor feedwater pump address this orifice or the lubrication system for the coupling.

The A-FRV lockup during level recovery following the scram was due to a missing resistor that is intended to prevent a FRV lockup when the controller is dialed to minimum. The resistor is not part of the controller as received from the vendor, rather it is added as a modification (implemented in 1974) prior to installation in the plant. The resistor was missing from the A-FRV controller because the controller had not been properly annotated upon receipt from the vendor in 1978 as needing this modification prior to installation during the 1995 refueling outage.

Analysis of Event:

This event had no adverse effect on the safe operation of the plant. The reactor scram occurred as designed upon receipt of the low reactor water level signal. Throughout the event, reactor vessel level and pressure were maintained within safe operating limits. All Engineered Safety Features (ESF) functioned as designed. The loss of a single feedwater pump is bounded by a total loss of feedwater event which is described in Section 15.6.3 of the Updated Final Safety Analysis Report (UFSAR) as a non-limiting event.

The reactor recirculation system responded as designed to the B-RFP trip by running the recirculation pumps back to 45% speed and reducing reactor power to approximately 62% (This is within the capability of one RFP during steady state conditions). When the B-RFP tripped, maximum flow through the A-RFP was promptly established. Based on the recirculation runback setpoint of 45% pump speed and the loss of one feedwater pump at 100% reactor power, a reactor scram on reactor water level less than 170 inches is a likely result and is consistent with results of tests conducted during initial plant startup in 1974. Section 7.7.1.3.4 of the UFSAR states that when one feedwater pump is lost and subsequent low water level exists, recirculation flow is limited to within the power capabilities of one feedwater pump and that this action aids in avoiding a low water level scram by limiting the steaming rate. UFSAR Section 1.3.2.8.1 implies that the runback of the recirculation pumps on a feedwater pump trip is designed to be fast enough to prevent a reactor scram.

Corrective Actions:

The coupling between the B-RFP and its shaft driven lube oil pump was replaced. The B-RFP .030 inch orifice was replaced with a .039 inch orifice. The A-RFP coupling was inspected and found to be in good condition and well lubricated. The A-RFP orifice was expanded from .030 inches to .039 inches. These actions were completed prior to startup.

The resistor missing from the A-FRV controller was installed prior to startup. Additionally, the part number descrip
ion for the controller
has been changed to ensure that a tag is placed on the controller upon receipt from the vendor stating that the resistor modification is required.

The plant maintenance procedure for the Reactor Feedwater Pumps is being revised to add activities and cautions intended to ensure proper oil flow through the lube oil pump drive shaft and orifice to the coupling. A caution is being added to guard against entry of foreign material during assembly of the feedwater pump and installation of the lube oil pump. This procedure is used during feedwater pump disassembly and inspection and this preventive maintenance activity is currently scheduled to be performed every third refueling outage. The vendor manual and plant drawings are also being revised to include information about the orifice and coupling. These revisions will be complete by July 31, 1995.

The UFSAR is being reviewed against the actual plant response to determine if it accurately reflects the likelihood of a scram upon the loss of one feedwater pump with the designed runback of the recirculation pumps.

The perceived slow response of the A-FRV had previously been identified and documented and is being reviewed and evaluated for possible corrective actions.

Additional Information:

A. Previous Similar Events:

A review of DAEC LERs since 1984 identified the following similar events:

LER 84-01 reports a scram from 100% power due to a decrease in feedwater flow to the vessel and relief valve actuation. LER 86-17 reports a scram from 5% power due to feedwater flow control problems. Neither of these scrams was caused by a single feedwater pump trip.

A scram at full power on low reactor water level due to a single RFP trip on low suction pressure occurred on June 3, 1983.

B. EIIS System and Component Codes:

Containment Atmosphere Monitoring System--IK
Reactor Feedwater Pump System--SJ
Reactor Recirculation Pump System--AD
Primary Containment Isolation System--JM
Reactor Water Cleanup System--CE
Emergency Core Cooling System--B
Turbine Bypass Valve System--JI
Lube Oil Pump System--LL
Feedwater Regulating Valve--LCV
Feedwater Regulating Valve Controller--PMC
Main Turbine--TRB
Safety Relief valve--RV
Coupling--CPLG
Orifice--OR
Potentiometer--FD

C. Equipment Information:

The reactor feedwater pumps were manufactured by Byron Jackson Pump Division of Borg Warner Corp., Model No. DVMX-3stage-10x12x16.

The shaft driven lube oil pumps were manufactured by Delaval Turbine/Transamerica Delaval, Model No. L31N-6B, and were purchased from Byron Jackson.

The feedwater regulating valve controllers were manufactured by General Electric Company, Model No. 544-05.

This report is being submitted pursuant to 10CFR50.73(a)(2)(iv).

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